[0024] Although the layers could have different thicknesses than those shown in the table below, the thicknesses shown produced the characteristics illustrated by the graphs of **FIGS. 2 and 3**.

Layer No.	Layer Thickness
layer 2	175 μM
layer 6	800 Å
layer 8	800 Å
layer 10	1500 Å
layer 12	500 Å

[0025] In accordance with another aspect of the invention, the light emitting device of **FIG. 1** may be fabricated as follows. In this example, the substrate **2** is a 175 μM thick (1 μM=10^{-6} meters) transparent polyester sheet precoated with a transparent, conducting ITO thin film **4**. The thickness of the flexible substrate may be either substantially thicker or thinner depending on the needs of the particular application which the OLED is used. The sheet resistance of the ITO thin film **4** was 60 Ω/□, and the transparency of the coated substrate was –80% throughout the visible spectrum. Prior to the deposition-of the organic film, the substrate **2** was ultrasonically cleaned in detergent for two minutes, then rinsed with deionized water. Next, it was rinsed in 2-propanol, held at room temperature for two to three minutes, and then boiled in 2-propanol again for two to three minutes, followed by drying with a blow gun using a stream of filtered dry nitrogen. An 800 Å thick layer **6** of the hole conducting material, TPD, was deposited by thermal evaporation in a vacuum of $<4\times10^{-7}$ Torr, followed by the deposition of a 800 Å thick Alq_3 layer. The top electrode consisted of a 1500 Å thick layer of Mg—Ag and a 500 Å thick Ag cap deposited through a shadow mask. A conventional device on an ITO-precoated glass substrate was simultaneously fabricated for comparison using identical cleaning and deposition procedures. The sheet resistance and transparency of the ITO-precoated glass substrate was 20 Ω/□ and –90%, respectively.

[0026] **FIG. 2** shows the current-voltage characteristics of a 1 mm diameter flexible device prior to bending, curve **16**, after repeated bending (4 to 5 times) over a small radius of curvature (–0.5 cm), curve **18**, and the conventional device on a glass substrate, curve **20**. All the current/voltage curves are shown to follow the power law dependence of current-on-voltage. At lower voltages, the current/voltage curves indicate ohmic behavior; while at higher voltages, the curves follow $I\approx V^{m+1}$ with m=7, suggestive of trap-limited conduction typical of OLED's. The power law dependence was observed for at least four orders of magnitude change in current in the high current region. There was no obvious change in the current/voltage characteristics after the device was repeatedly flexed. The turn-on voltages (defined as the voltages at which the current due to ohmic and trap limited conduction are equal) of the three curves was almost identical (–6.5V), while the leakage current at low voltages of the flexible device was even less than that of the conventional device, and was not increased after bending. This indicated that the ITO film precoated on the flexible substrate is sufficiently uniform such that current shunt paths between the top and bottom contacts **12** and **4** are not induced after bending, even for very thin film (–1600 Å molecular organic structures).

[0027] The light output power versus current (L-I) characteristics of the flexible device before and after bending, and of the conventional device are shown in **FIG. 3** by graph **22**. Curve **24** illustrates the L-I output of a standard device having a glass substrate. The external quantum efficiency of the flexible device was 0.20%, and that of the conventional device was 0.14%. In both cases, the efficiency was calculated from light emitted only in the forward scattering direction. This considerably underestimates the true quantum efficiency but is useful for comparing between devices. Once again, the quantum efficiency of the flexible device was demonstrated not to be affected by repeated bending. The fact that there was no appreciable change in either the I-V or L-I characteristics after the device was flexed indicated that the ITO contact, the organic layers, and the alloy top contact were not significantly affected by bending even over a small radius of curvature.

[0028] Large-area (–1 cm^2) devices were also fabricated by similar methods. As in the case of the smaller devices, the large devices were also be bent over radii of –0.5 cm without apparent degradation. That these larger areas can be achieved indicates that flexible OLED's can be used in large, roll-up, or conformable flat panel displays. This, in conjunction with the fact that the ITO-precoated substrate is available in large spools, indicates that flexible, OLED-based displays can be mass manufactured on a roll-to-roll basis by use of suitable volume growth technologies such as organic vapor phase deposition.

[0029] Failure modes of the large-area device were also studied. If on the convex side of a curved substrate the device can be bent without failure even after a permanent fold occurs in the polyester film. If on the concave side the device remains operational when bent over a radius of curvature down to 0.5 cm. At smaller radii, cracks propagate through the device, and current-shunt paths are created between bottom and top contacts after further bending. When ITO-precoated substrates are similarly bent, the same cracking phenomenon is observed, from which it can be inferred that the cracks occur in the ITO rather than in the OLED itself.

[0030] In conclusion, vacuum-deposited, van der Waals-bonded, non-polymeric flexible OLED's, such as illustrated in **FIG. 5**, have been fabricated using an ITO-precoated transparent polyester film as the substrate. It has been shown that an ITO thin film, when precoated on a flexible substrate, provides a flat, highly transparent, conductive, flexible contact suitable for OLED applications. This hole-injecting ITO-coated substrate may also be used with OLED's comprising polymeric hole transporting, electron transporting, and/or emissive layers comprised of polymers. In addition, performance similar to that disclosed herein is expected if non-polymeric devices are vacuum deposited on polymeric, transparent hole-injecting contacts such as polyaniline, which may be useful if even greater flexibility is required in certain applications.

[0031] Although a particular OLED structure of **FIG. 1** has been described, it is to be understood that any OLED structure having layers that are vacuum formed could be formed on a flexible polymeric substrate in accordance with this invention. Those of skill in the art may recognize certain